

Gravel Mining 101

Production of Construction Aggregates



Raw material to finished products



Every year— 42,719 pounds of new minerals must be provided for every person in the United States to make the things we use, every day

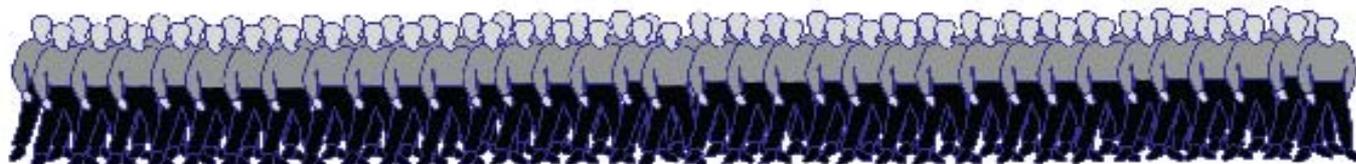
-  9,871 lbs. **Stone** used to make roads; buildings; bridges; landscaping; numerous chemical and construction uses
-  7,811 lbs. **Sand & Gravel** used to make concrete; asphalt; roads; blocks & bricks
-  714 lbs. **Cement** used to make roads; sidewalks; bridges; buildings; schools; houses
-  377 lbs. **Iron Ore** used to make steel— buildings; cars, trucks, planes, & trains; other construction; containers
-  400 lbs. **Salt** used in various chemicals; highway deicing; food & agriculture
-  247 lbs. **Phosphate Rock** used to make fertilizers to grow food; animal feed supplements
-  204 lbs. **Clays** used to make floor & wall tile; dinnerware; kitty litter; bricks & cement; paper
-  84 lbs. **Aluminum (Bauxite)** used to make buildings; beverage containers; autos; airplanes

-  15 lbs. **Copper** used in buildings; electrical & electronic parts; plumbing; transportation
-  12 lbs. **Lead** 75% used for transportation— batteries; electrical; communications; TV screens
-  7 lbs. **Zinc** used to make metals rust resistant; various metals & alloys; paint; rubber; skin creams; health care; and nutrition
-  44 lbs. **Soda Ash** used to make all kinds of glass, in powdered detergents, medicines, as a food additive, photography, water treatment.
-  7 lbs. **Manganese** used to make almost all steels for: construction; machinery; transportation
-  544 lbs. **Other Nonmetals** numerous uses glass; chemicals; soaps; paper; computers; cell phones; etc.
-  26 lbs. **Other Metals** numerous uses same as nonmetals, but also electronics; TV & video equipment; recreation equipment; etc.

Plus These Energy Fuels

- 979 gallons of **Petroleum**
- 7,378 lbs. of **Coal**
- 78,473 cu. ft. of **Natural Gas**
- 1/4 lb. of **Uranium**

To generate the energy each person uses in one year—
equivalent to 300 people working around the clock for each of us.



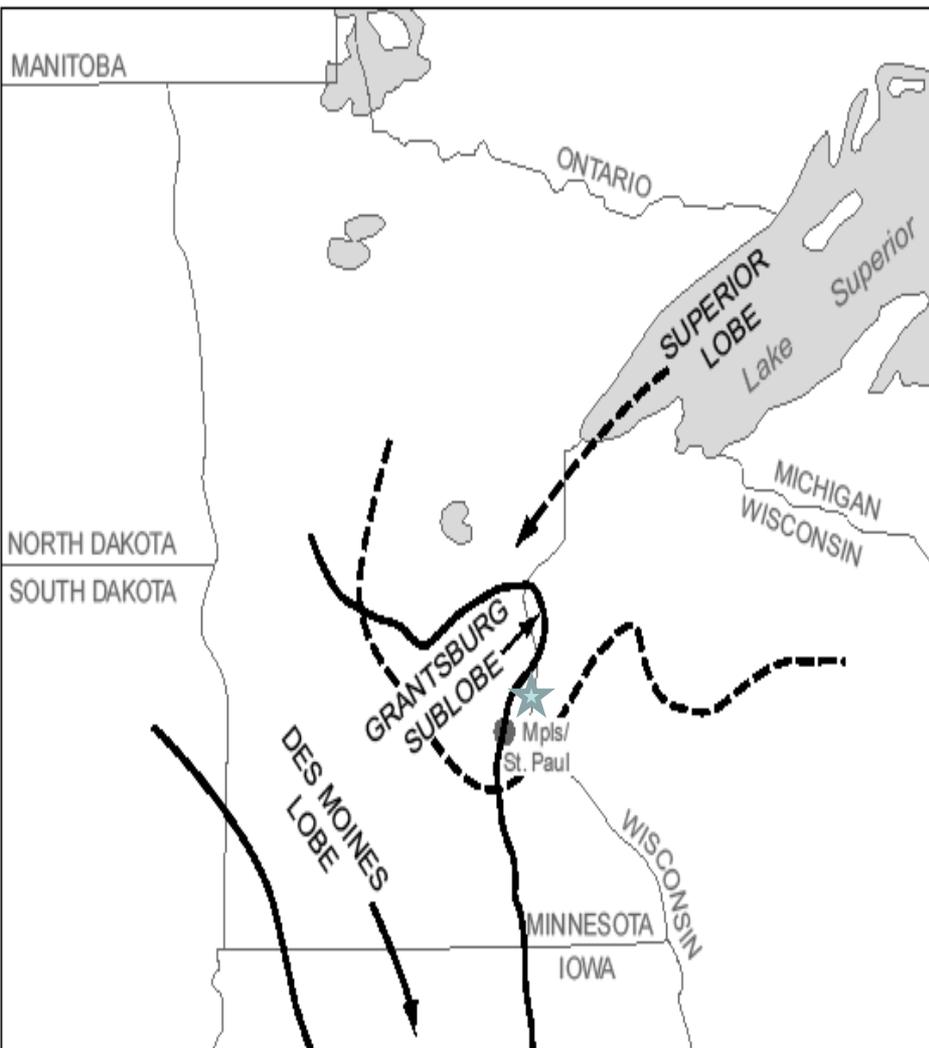
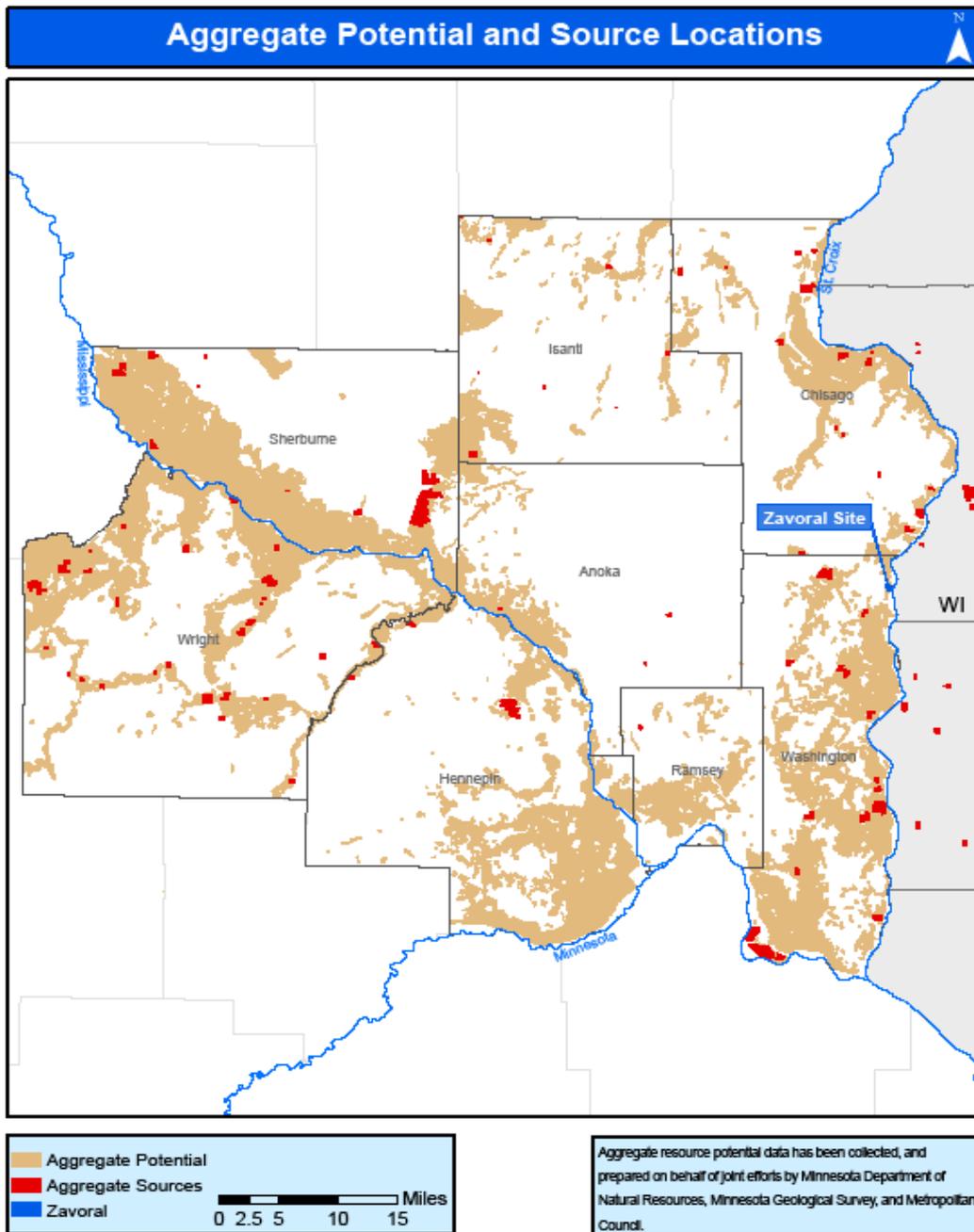


Figure 5. Map of Minnesota showing movement direction and maximum extent of Superior-lobe ice, and the later Des Moines-lobe ice. Note the northeast-directed Grantsburg sublobe of the Des Moines lobe.

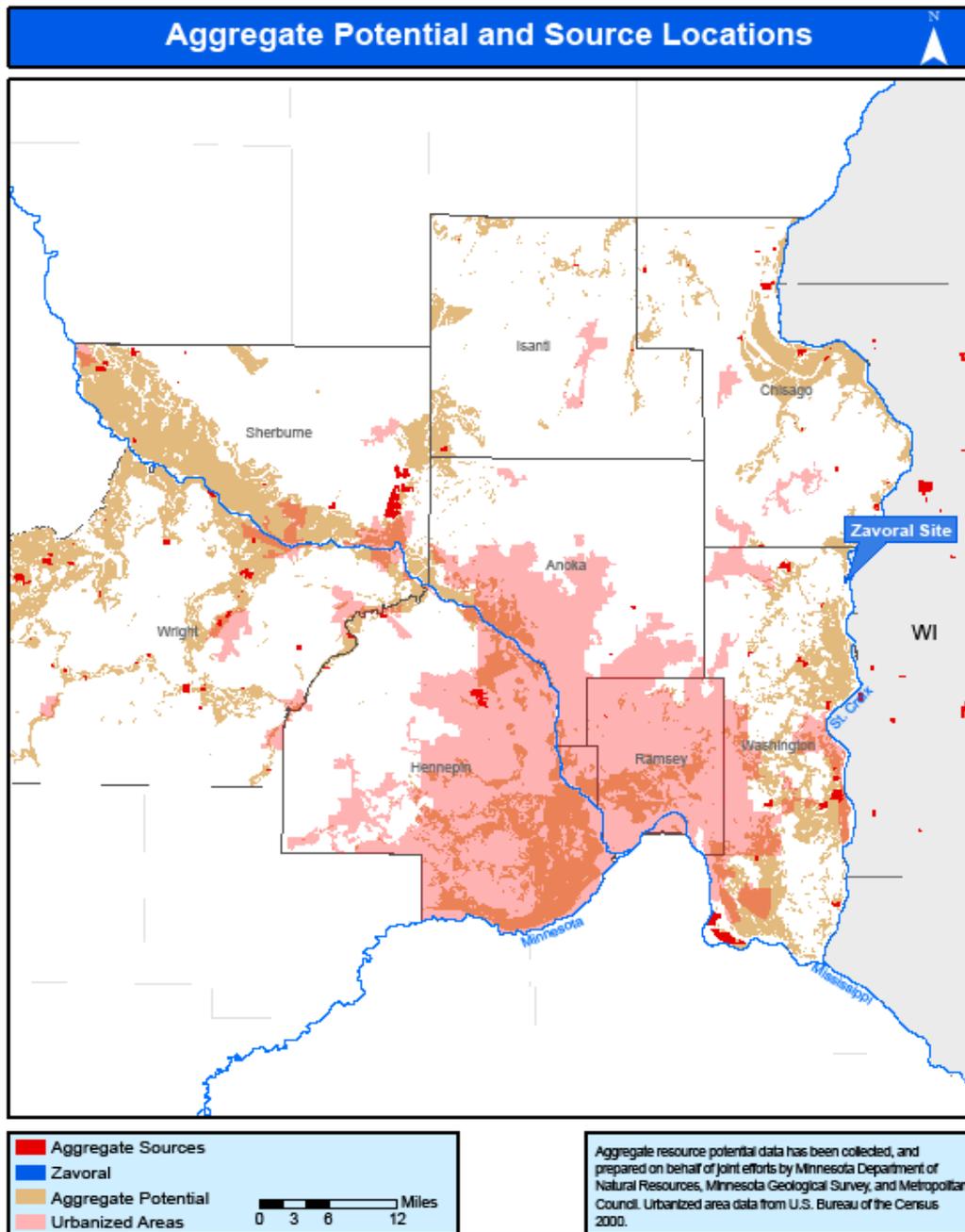
“The **Superior-lobe** gravels contain abundant particles of strong, non-reactive crystalline rock, and only minor amounts of undesirable rock types such as shale or sulfide-bearing slate.”

“Sand and gravel deposits laid down by meltwater from the **Des Moines lobe** contain particles of shale, and are therefore of lower quality as construction aggregate.”

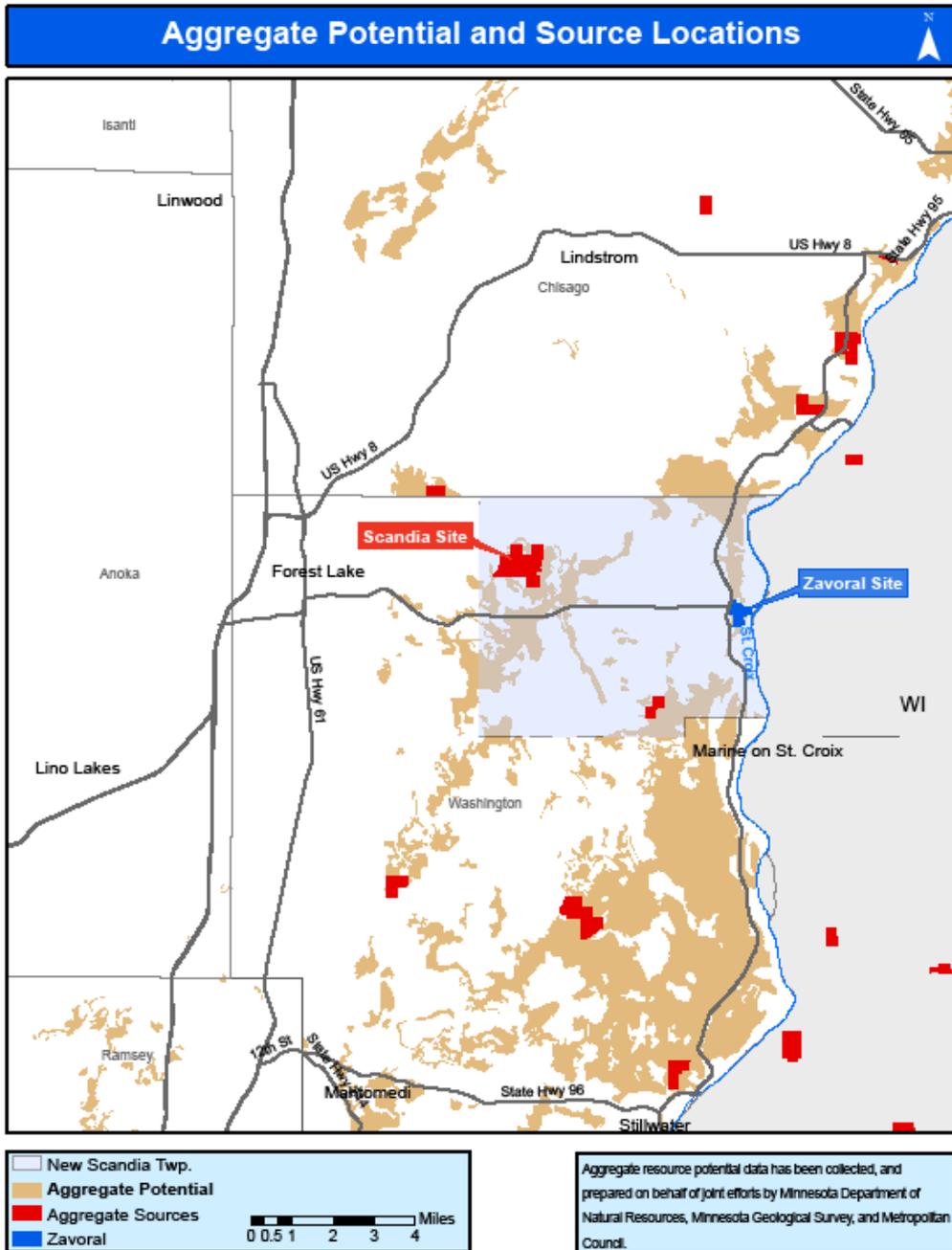


“Economically viable deposits of sand and gravel, or bedrock appropriate for crushing, are where they are, whether convenient or not.”

(Southwick et al., 2000)



“The availability of the best remaining Superior-lobe sand and gravel deposits in eastern Washington and central Dakota counties, is threatened by suburban sprawl.”
 (Southwick et al. 2000)



“A pit in section 18 near the intersection of Minnesota Highways 95 and 97 produced samples that average 0.25 percent each of shale, iron oxide, and unsound chert.”

(Southwick et al., 2000)

Exposed mining face



- Demonstrates the unconsolidated nature of glacial deposits

- Note the range of grain sizes:

Fine-grained sand---coarse-grained gravel

- A mining site that is lacking a particular grain size may need to bring in “add rock” to supplement the specifications for different products

Grain Size Distribution and Classification Chart

Millimeters (mm)	Micrometers (μm)	Phi (ϕ)	Wentworth size class	
4096		-12.0	Boulder	Gravel
256		-8.0	Cobble	
64		-6.0	Pebble	
4		-2.0	Granule	
2.00		-1.0	Very coarse sand	
1.00		0.0	Coarse sand	Sand
1/2	0.50	1.0	Medium sand	
1/4	0.25	2.0	Fine sand	
1/8	0.125	3.0	Very fine sand	
1/16	0.0625	4.0	Coarse silt	
1/32	0.031	5.0	Medium silt	Silt
1/64	0.0156	6.0	Fine silt	
1/128	0.0078	7.0	Very fine silt	
1/256	0.0039	8.0	Clay	Mud
	0.00006	14.0		

- To make a product, material must be sorted according to its grain size

- Material is passed through sieves (screens) to achieve the required grain size distribution for a specific product

CONSTRUCTION AGGREGATE SPECIFICATIONS

Example of variety of products

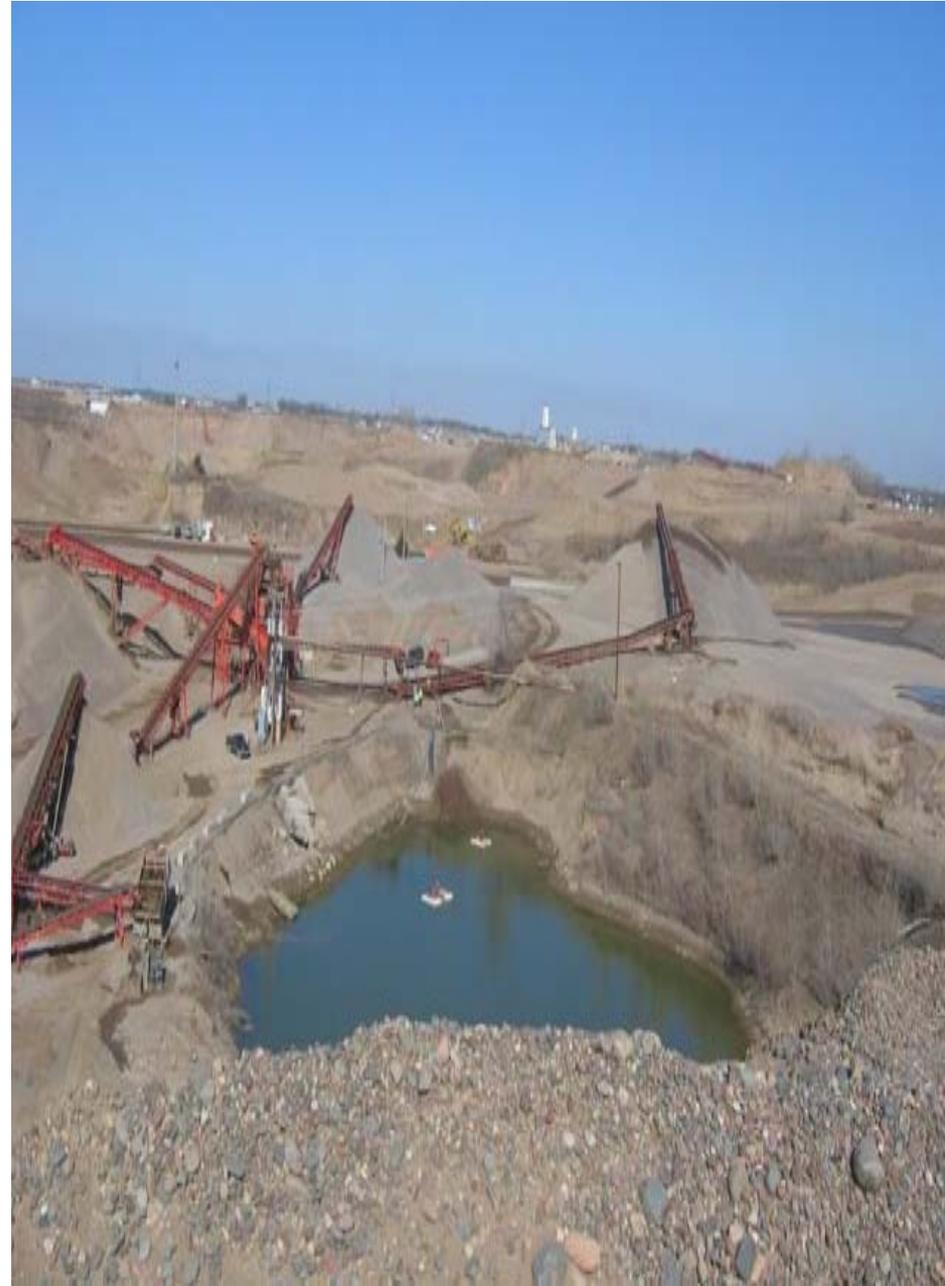
- Bagged Portland Cement
- Fine Aggregate for Portland Cement (**must be washed**)
- Fine Aggregate for Bituminous Seal Coat
- Coarse Aggregate for Concrete
- Mortar Sand
- Base and Surfacing Aggregate (**Crushing required for Class 5 and Class 6**)
- Stabilizing Aggregate
- Aggregate Backfill
- Aggregate Bedding
- Coarse Filter Aggregate (**no fines – Generally requires washing**)
- Fine Filter Aggregate

Table 3138-1
Base Surfacing Aggregate
Total Percent Passing

Sieve Size	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
75 mm (3 inches)	--	--	--	--	--	--
50 mm (2 inches)	--	--	100	100	--	--
37.5 mm (1½ inches)	--	--	--	--	--	--
25.0 mm (1 inch)	--	--	--	--	100	100
19.0 mm (¾ inch)	100	100	--	--	90-100	90-100
9.5 mm (3/8 inch)	65-95.	65-90	--	--	50-90	50-85
4.75 mm (# 4)	40-85.	35-70	35-100	35-100	35-80	35-70
2.00 mm (# 10)	25-70	25-45	20-100	20-100	20-650	20-55
425 µm (# 40)	10-45	12-30	5-50	5-35	10-35	10-30
75 µm (# 200)	8.0-15.0	5.0-13.0	5.0-10.0	4.0-10.0	3.0-10.0	3.0-7.0

*Modified from Table 3138-1 of the Standard Specifications For Construction, 2005 Edition: Minnesota Department of Transportation.

Operations Overview-Maple Grove, MN



Comparative Local Water Usage

	Permitted MG/Year
Abrahamson Nurseries	7.3
Barton Sand and Gravel	18.0
Eco Bakken	38.0
Forest Hills Golf Club	37.0
City of Forest Lake	2850

Add Rock= The Modern Plan

- Add Rock allows gravel mining to operate efficiently.
- Add Rock does not extend the life of a mining operation, instead, it allows the producers to use 100% of the material to make a product---ALL of the resource is utilized.
- The amount of Add Rock required is a function of gradations existing at the mine, and the material specification required for specific products.
- Aggregate is too precious a resource to let go to waste.